S&E SCIENCE AND THE ENVIRONMENT Bulletin

Welcome to the first issue of ***Science and the Environment Bulletin,***

part of Environment Canada's commitment to sharing the results of its science with Canadians. The **Science and Environment Bulletin** will provide important and timely information on issues such as climate change, smog, nature and toxics.

S&E can be found at www.ec.gc.ca/science.

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For more information, email: Roger.White@ec.gc.ca

Canada Country Study:

A Window on Climate Change in Canada

Over the next century, global temperatures are projected to undergo a change greater than any seen in the past 10,000 years. Scientists know this will cause unprecedented disruptions in the earth's climate which will vary from place to place and produce a wide range of impacts.

The **Canada Country Study** is the first-ever national assessment of the social, biological, and economic impacts of climate change for Canada. Environment Canada has brought together climate experts from government, industry, academia, and non-government organizations to review existing knowledge on climate change impacts and adaptation; identify gaps in research; and suggest priority areas where new knowledge is urgently needed.

In Canada, there has been warming of about 1°C over the past century, with increased annual precipitation over the past 50 years. These figures are consistent with global trends. Climate change projections suggest that over the next century, further warming of 1 to 3.5°C will occur. Based on this scenario, the **Canada Country Study** found that the implications of climate change for water resources are a key to defining overall impacts for all sectors and regions of the country.

Overall, the impacts of climate change on our forests, fish populations, and agriculture could be extreme. They include:

- longer growing seasons and extension of agriculture further north, but also risks to agriculture such as moisture deficits, pests, disease, and fires;
- impacts on fish populations, which could increase in some areas mostly in the Arctic and

continued

Global Climate Change

continued

on northern areas of the Pacific coast, and decrease in others, particularly the lakes and rivers of the Canadian Shield;

- effects on hydroelectric generating potential, with increases in Labrador and Northern Quebec, and lower potential in Ontario, the Prairies, and southeastern B.C.;
- risks to waterfowl populations due to lower water levels in lakes, rivers, and wetlands; and
- projected changes in the occurrence and severity of extreme events, which would have serious implications for the security and integrity of Canada's natural resources, social systems, and infrastructure with subsequent implications for the insurance industry and supporting public sectors.

In looking at the impacts for Canada, the study drew upon 26 component reports covering six regions of Canada and 20 sectoral and related issues of socio-economic significance. Highlights of the regional reports are included here. It is important to bear in mind that uncertainties regarding the character, magnitude, and rates of future climate change remain. These uncertainties impose limitations on the ability of scientists to project impacts of climate change, particularly at the regional and smaller scales.

British Columbia/Yukon

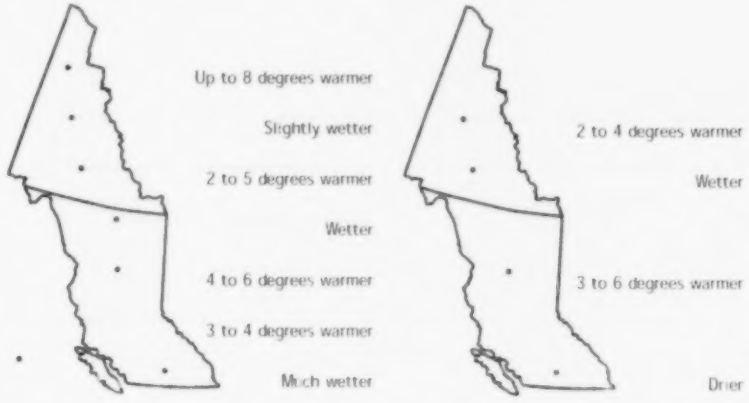
Climate change will have significant impacts on British Columbia and Yukon, including increased flood dangers in some areas, drought in others, and widespread disruption to forests, fisheries, and wildlife.

Sea levels are expected to rise up to 30 cm on the north coast of B.C. and up to 50 cm on the north Yukon coast by 2050, mainly due to warmer ocean temperatures. This could cause increased sedimentation, coastal flooding, and permanent inundation of some natural ecosystems, and place low-lying homes, docks, and port facilities at risk.

Other changes that may result from climate change include:

- In **winter**, increased winter precipitation, permafrost degradation, and glacier retreat due to warmer temperatures may lead to landslides in unstable mountainous regions, and put fish and wildlife habitat, roads, and other man-made structures at risk. Increased precipitation will put greater stress on water and sewage systems, while glacier reduction could affect the flow of rivers and streams that depend on glacier water, with potential negative impacts on tourism, hydroelectric generation, fish habitat, and lifestyles.
- **Spring** flood damage could be more severe both on the coast and throughout the interior of B.C. and Yukon, and existing flood protection works may no longer be adequate.
- **Summer** droughts along the south coast and southern interior will mean decreased stream flow in those areas, putting fish survival at risk, and reducing water supplies in the dry summer season when irrigation and domestic water use is greatest.

Climate Change Scenarios for British Columbia and Yukon
Seasonal Temperature and Precipitation Changes



Arctic

In the past 100 years, the Mackenzie district has warmed by 1.5°C and the Arctic tundra area by 0.5°, while the Arctic mountains and fjords of the eastern Arctic have cooled slightly. Future winter temperature increases of 5-7° over the mainland and much of the Arctic Islands and modest cooling in the extreme eastern Arctic are projected. Summer temperatures are expected to increase up to 5° on the mainland, and 1-2° over marine areas. Annual precipitation is expected to increase up to 25 per cent.

These changes in temperature and precipitation would have dramatic effects on tundra and taiga/tundra ecosystems, reducing them by as much as two thirds of their present size. More than one half of the discontinuous permafrost area could disappear, with marked surface instability in the short term.

Wildlife would also be affected, with many species in fish and streams shifting northward – 150 km for each degree increase in air temperature – and High Arctic Peary caribou, muskoxen, and polar bears running the risk of extinction.

Climate change would also extend the shipping season in the Arctic, while rising sea levels in the Beaufort Sea areas would endanger coastal infrastructure.

Prairies

Current models suggest that climate change could result in increased air temperatures and decreased soil moisture. There is less confidence about whether precipitation will increase or decrease or about how climate change may affect severe weather events. Most scenarios suggest that the semi-arid regions of the prairies can expect an increase in the frequency and length of droughts.

Some of the potential impacts of these changes include:

- Average potential crop yields could fall by 10-30 per cent, due to higher temperatures and lower soil moisture. However, higher temperatures could lengthen the growing season, and may increase crop production in northern regions where suitable soils exist.
- Increased demand for water pumping and summer cooling, due to drought, and decreased winter demand due to higher temperatures, could push electrical utilities into a summer peak load position at the same time as hydropower production is reduced by decreased water flow. This could result in increased thermal power production with an increase in fossil fuel consumption and greenhouse gas emissions.
- Semi-permanent and seasonal wetlands could dry up, leading to reduced production of waterfowl and other wildlife species.

Ontario

Ontario could experience anywhere from 3-8°C average annual warming by the latter part of the 21st century, leading to fewer weeks of snow, a longer growing season, less moisture in the soil, and an increase in the frequency and severity of droughts.

Other impacts of climate change could include:

- more days when heat stress and air pollution adversely affect people's health;
- likely increases in the frequency and severity of forest fires;
- changes to aquatic ecosystems and alterations to wetlands;

As well, water levels in the Great Lakes could decline to record lows by the latter part of the 21st century, reducing shipping capacity.

Facts & Figures

Farmers in Renfrew County, west of Ottawa, had the longest dry spell since 1940 and some were forced to sell cattle to make payments.

– Summer of '97 Highlight.

Quebec

If carbon dioxide levels were to double, Quebec would experience average temperature increases of 1-4°C in the south and 2-6° in the north. Precipitation would likely remain the same or decrease slightly in the south, while increasing 10-20 per cent in the north.

Likely consequences include:

- lower water levels in the St. Lawrence River, which will affect shipping, navigation, and the marine environment of the river;
- positive effects on agriculture, including a longer growing season and the extension of agriculture further north.

1995 releases of NPRI Pollutants Decline

Figures from Environment Canada show that releases of pollutants reported to the National Pollutant Release Inventory (NPRI) are down by six per cent from 1994 levels.

The NPRI is at the heart of Environment Canada's efforts to inform Canadians about pollution. The NPRI is a nationwide, publicly accessible database of releases and transfers of 176 pollutants released to air, water and land in Canada. Reports to Environment Canada are required from any facility that manufactures, processes or uses one or more of the 178 NPRI substances in quantities of ten tonnes per year or more, and in concentrations of one per cent or greater. The reporting requirement affects those operations with the equivalent of ten full-time employees.

A total of 1,758 facilities reported releases of 169,070 tonnes of pollutants to the NPRI in 1995, the most recent year for which figures are available. Most of the pollutants (102,538 tonnes, or 60 percent) were released to air, an increase of five percent from 1994. There was a 37 per cent decrease from 1994 in reported releases to water (34,409 tonnes). Almost 10 per cent of NPRI pollutants

continued

Atlantic

Climate change in the Atlantic region has not followed the national warming trend of the past century, and, in fact, a slight cooling trend has been experienced over the past 50 years. This trend is consistent with projections by climate models.

Atlantic Canada is particularly vulnerable, however, to rising sea levels, whose impacts could include greater risk of floods; coastal erosion; coastal sedimentation; and reductions in sea and river ice.

Other potential impacts include:

- loss of fish habitat;
- changes in ice-free days, which could affect marine transportation and the offshore oil and gas industry; and
- changes in range, distribution, and breeding success rates of seabirds.

For more information, see Environment Canada's Green Lane at www.ec.gc.ca/climate/cs/index.htm

Facts & Figures

The wind chill was -2 when the replica of John Cabot's ship arrived on June 24th in Bonavista, Newfoundland.

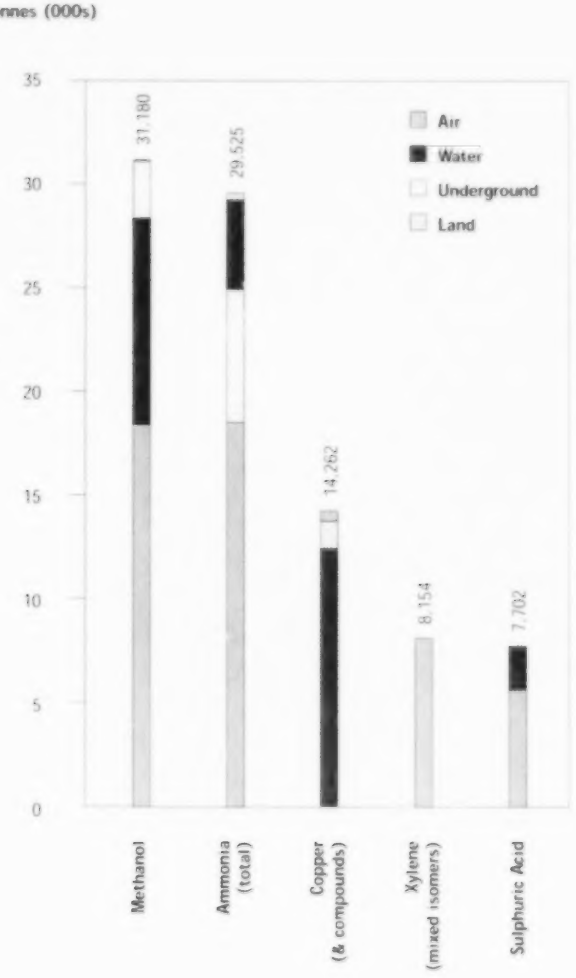
– Summer of '97 Highlight.

were injected underground (16,086 tonnes), up 20 percent from 1994. Releases to land were up 12 per cent from 1994 (at 15,822 tonnes).

Methanol remains at the top of the list of pollutants, with releases totaling 31,180 tonnes, while ammonia was second at 29,525 tonnes. Copper and its compounds (14,262 tonnes), xylene (8,154 tonnes) and sulphuric acid (7,702 tonnes) round out the top five substances on the list, which account for 54 percent of all releases.

There was an increase of one per cent in the number of facilities making NPRI reports because of outreach and compliance promotion, and also because of a change in NPRI reporting requirements. Calculations now include by-products, so that large quantities of releases produced as by-products, but at low concentrations, are also captured in the data.

Highest Five NPRI pollutants released in Canada in 1995



The full NPRI report is available as an electronic database on Environment Canada's Green Lane at *http://www.ec.gc.ca/pdb/npri.html*. By downloading software from the NPRI home page, users can search the database and find detailed information on individual substances, specific facilities or geographic areas.

NPRI data are used for a variety of purposes. The data support a number of activities at Environment Canada, including pollution prevention planning, and the development of control options on substances which can harm the environment or human health. They are also used by the NAFTA Commission on Environmental Co-operation to compare environmental performance in Canada, the United States and Mexico. This comparative information is useful in developing a continental approach to reducing releases to the environment and transfers in waste of toxic substances.

The 1995 NPRI report is available from Environment Canada's Enquiry Centre, at 1-800-668-6767.

Emissions Control Tampering: Five Year Summary

A new report summarizing data from Vehicle Emissions Inspection Clinics held across Canada from 1991 to 1995 suggests there is still a problem with missing or malfunctioning pollution control equipment on cars and light trucks.

Of the 8,240 vehicles inspected over the period, 15 per cent had at least one emissions component that was missing , damaged or in some state of disrepair. The average tampering rate for the key anti-pollution device, catalytic converters, was five per cent. Given the importance of this emissions control device, such a level of tampering is serious. There appears to be a trend toward damaged, removed or disconnected emissions control devices in older vehicles. For instance, at least one component was tampered with in 25 per cent of cars that were eight years old at the time of inspection, compared to a three per cent rate in cars less than one year old.

Idle emissions tests were performed on about 7,800 vehicles over the five years of testing. Approximately 15 per cent of the tested vehicles had carbon monoxide emissions that exceeded a set of lenient pass/fail criteria, and 16 per cent of the vehicles had hydrocarbon emissions in excess of similarly lenient criteria. These vehicles would have failed the idle portion of most inspection and maintenance programs operating in the United States.

Emissions from cars and light trucks have far-reaching effects on the environment, and well-maintained pollution control equipment is important to reducing smog. In fact, cars and light trucks account for one-third of Canada's human-induced hydrocarbons, carbon monoxide and oxides of nitrogen (a smog precursor). To help drivers understand the importance of properly functioning anti-pollution systems, Environment Canada has a long tradition of operating summer Vehicle Emissions Inspection Clinics in cooperation with provincial agencies. These clinics are a tool to increase public awareness, and also provide information about the vehicles in use by the Canadian public.

The results are contained in the report: *A Summary of Data from Vehicle Emissions Inspection Clinics Held in Canada (1991 to 1995).*

Facts & Figures

There were 5,681 wildfires across Canada as of September 3rd, only two-thirds of the 10-year average and the fewest number in 25 years.

– Summer of '97 Highlight.

The second heaviest one-day rainfall ever recorded in July in Vancouver, 37 mm, occurred on July 7th.

– Summer of '97 Highlight.

Committee on the Recovery of Nationally Endangered Wildlife (RENEW) Issues Seventh Report

A new population of Blanding's turtle has been discovered in Nova Scotia, the Newfoundland marten has been moved to the endangered list and Baird's sparrow has been delisted in the prairies.

These are among the key findings of the 7th RENEW Report for 1996-97, which provides information on recovery efforts aimed at 40 endangered species that are currently the focus of recovery efforts. The report outlines where progress is being made to conserve endangered species in Canada and where more attention is needed.

The report is issued by the Committee on the Recovery of Nationally Endangered Wildlife (RENEW). Representatives of federal, provincial, and territorial governments and of three non-governmental wildlife organizations make up the committee.

The report found:

- The Newfoundland marten population, unique to the old growth forests of the province, was moved from threatened to endangered status because of the precarious state of the population, which is now estimated to be around 300 individuals. Biologists launched a captive breeding program in 1996; seven young were born in the spring from females who were pregnant when captured. A training pen was constructed to teach the young how to hunt prior to their fall 1997 release.
- The population of Blanding's turtle inside Nova Scotia's Kejimkujik National Park is about 130 adults, slightly lower than last year. However, scientists have discovered that at least one significant population exists outside the park. The recovery team for the turtle monitored hatchlings grown in captivity and released, and found their behaviour similar to that of wild juveniles.
- Researchers estimate a population that could be over one million for Baird's sparrows in Saskatchewan. Sparrows were found in a diversity of habitats, indicating a high level of adaptability, and they are no longer considered at risk.
- The 2nd international census of piping plovers breeding populations found 2,111 birds in Canada. Of these, 1,687 adult birds were in the prairie population, an increase of 250 since the 1991 census, and 426 were in Atlantic Canada, a decrease of 87 birds. The beach-dwelling shorebird remains at risk due to low numbers, sparse distribution, and continued threats to its habitat and reproductive success. A recovery plan submitted in 1997 aims to achieve a viable population of at least 2,296 adult plovers within five years.

Of the 281 wildlife species listed as at risk in Canada, 13 are extirpated (no longer existing in the wild in Canada), 67 are endangered, 70 threatened, and 131 vulnerable.

Science Review finds UV Levels to Remain High

A scientific review of Canadian research on the ozone layer found that ozone thinning is continuing over Canada and that sunburning UV (ultra violet) levels have increased by about seven per cent. The Environment Canada study, "Ozone Science: A Canadian Perspective on the Changing Ozone Layer," stated that UV levels are expected to remain higher than normal for the next 50 years, leading to impacts on human health, crops, forests and aquatic ecosystems.

Human health effects from increased UV levels include skin cancer, immune suppression, higher numbers of infectious diseases and eye damage. Many of these effects appear to be related to cumulative exposure and are inter-linked. For example, UV radiation may suppress the human immune response, increasing the risk of skin cancer and bacterial and viral infection.

In agriculture, the study found that a five per cent increase in UV would result in losses to sensitive crops of $89 million per year. A 10 per cent increase in UV would result in losses of $192 million each year in crop yields.

Efforts to reduce ozone-depleting substances, established in the Montreal Protocol, are having an effect. Measurements show that the build-up of the most significant CFCs in the lower atmosphere has slowed considerably. One of the key chemicals (CFC 11) is now decreasing. Scientists expect the ozone layer to recover by the year 2050.

In the next S&E Bulletin...

Look for highlights of the comprehensive science review on smog. This review shows that smog continues to pose a health threat to millions of Canadians.

The science review accompanied the Phase Two Federal Smog Management Plan, recently released by the Government of Canada. It summarizes the current state of Canadian knowledge about nitrogen oxides (NOx) and volatile organic compounds (VOC) which combine to form ground-level ozone, the key component of smog.

The science review makes 14 recommendations in the areas of effects on human health and vegetation and the reduction of domestic emissions, as well as transboundary transport, monitoring, further research, and improvement of science tools.

Facts & Figures

Nova Scotia received less than 10% of the month's average rainfall in July of '97...fewer than 8 mm of rain in some areas...an all time low.

– Summer of '97 Highlight.

Many of the reports highlighted in the Bulletin can be obtained from Environment Canada's Inquiry Centre at **1-800-668-6767**

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